

AMENDMENTS TO THE CLAIMS

1.(currently amended) A telemetry receiver system for detecting a signal, said telemetry receiver system comprising:

- (a) a transformer which measures a modulated signal current created in a drill ~~string pipe~~; and
- (b) a current receiver cooperating with said transformer
 - (i) to measure a response signal induced in said transformer by said modulated signal current, and
 - (ii) to demodulate said response signal to obtain said signal.

2.(currently amended) The telemetry receiver system of claim 1 wherein said transformer comprises a toroid transformer surrounding said drill ~~string pipe~~.

3.(currently amended) ~~The A~~ telemetry receiver system of claim 1 for detecting a signal, said telemetry receiver system comprising:

- (a) a plurality of ~~said~~ transformers each of which measures a modulated signal current created in a drill string; and
- (b) a current receiver cooperating with each of said plurality of transformers
 - (i) to measure a response signals induced in each said transformer by said modulated signal current, and
 - (ii) to demodulate said response signals to obtain said signal; wherein;
- (ac) at least one of said plurality of transformers comprises a toroid transformer surrounding said drill string;
- (bd) at least one said plurality of transformers comprises a toroid transformer disposed on a rig operating said drill string; and
- (ee) outputs from said plurality of transformers are combined to yield said signal with an enhanced signal to noise ratio.

4.(original) The telemetry receiver system of claim 1 further comprising an rig voltage receiver, wherein:

(a) said rig voltage receiver measures a modulated voltage signal resulting from said modulated signal current; and

(b) output of said rig voltage receiver and said current receiver are combined to yield said signal with an enhanced signal to noise ratio.

5.(original) The telemetry receiver system of claim 1 wherein:

(a) said transformer is disposed in an annulus defined by a wall of a borehole and an outside diameter of casing;

(b) said current receiver is disposed at the surface of the earth; and

(c) said transformer and said receiver are operationally connected by means of a communication link.

6.(currently amended) The telemetry receiver system of claim 1 wherein said transformer is disposed underwater at a location where said drill ~~string~~ pipe enters a borehole.

7.(currently amended) The telemetry receiver system of claim 1 wherein said transformer is disposed around casing encompassing a drill ~~string~~ pipe operating through a template, wherein said template incorporates at least one completed well.

8.(original) The telemetry receiver system of claim 1 wherein said response signal is a voltage.

9.(original) The telemetry receiver system of claim 1 wherein said response signal is a current.

10.(currently amended) A measurement-while-drilling telemetry system comprising:

(a) a transmitter disposed within a downhole assembly, wherein said transmitter ~~creates~~ cooperates with a sensor to create a modulated signal current in a drill string; and

(b) a telemetry receiver system comprising

(i) a transformer which measures said modulated signal current, and
(ii) a current receiver cooperating with said transformer
to measure a response signal induced in said transformer by
said signal current, and
to demodulate said response signal to yield a signal from
said transmitter.

11.(original) The telemetry system of claim 10 wherein said transformer comprises a toroid transformer surrounding said drill string.

12.(currently amended) ~~The telemetry system of claim 10~~ A measurement-while-drilling telemetry system comprising:

(a) a transmitter disposed within a downhole assembly, wherein said transmitter creates a modulated signal current in a drill string; and

(b) a telemetry receiver system comprising

(i) a plurality of transformers each of which measures said modulated signal current, and

(ii) a current receiver cooperating with said each said transformer to measure a response signal induced in each said transformer by said signal current, and

to demodulate said response signal to yield a signal from each said transformer; wherein said telemetry receiver system comprises a plurality of said transformers wherein:

(ac) at least one of said plurality of transformers comprises a toroid transformer surrounding said drill string;

(bd) at least one said plurality of transformers comprises a toroid transformer disposed on a rig operating said drill string; and

(e e) outputs from said plurality of transformers are combined to yield said signal with an enhanced signal to noise ratio.

13.(original) The telemetry system of claim 10 further comprising a rig voltage receiver, wherein:

- (a) said rig voltage receiver measures a modulated voltage signal resulting from said modulated signal current; and
- (b) output of said rig voltage receiver and said current receiver are combined to yield said signal with an enhanced signal to noise ratio.

14.(original) The telemetry system of claim 10 wherein said response signal is a voltage.

15.(original) The telemetry system of claim 10 wherein said response signal is a current.

16.(currently amended) A MWD system comprising:

(a) a downhole assembly which terminates a lower end of a drill string, wherein said downhole assembly comprises

- (i) a sensor, and
- (ii) a transmitter, wherein said transmitter ~~creates~~ is electrically connected to said sensor to create a modulated signal current in said drill string which is indicative of a response of said sensor to a parameter of interest; and

(b) a telemetry receiver system comprising

- (i) a transformer which measures said modulated signal current, and
- (ii) a current receiver cooperating with said transformer, wherein said current receiver measures a response signal induced in said transformer by said signal current, and demodulates said response signal to yield said response of said sensor.

17.(original) The MWD system of claim 16 wherein said transformer comprises a toroid transformer surrounding said drill string.

18.(original) The MWD system of claim 16 further comprising surface equipment for converting said response of said sensor into said parameter of interest.

19.(currently amended) ~~The MWD system of claim 16 wherein said telemetry receiver system comprises a plurality of said transformers, wherein:~~ A MWD system comprising:

(a) a downhole assembly which terminates a lower end of a drill string, wherein said downhole assembly comprises

(i) a sensor, and

(ii) a transmitter, wherein said transmitter creates a modulated signal current in said drill string which is indicative of a response of said sensor to a parameter of interest; and

(b) a telemetry receiver system comprising

(i) a plurality of transformers each of which measures said modulated signal current, and

(ii) a current receiver cooperating with each said transformer, wherein said current receiver measures a response signal induced in each said transformer by said signal current, and demodulates said response signal to yield said response of said sensor; wherein

(ac) at least one of said plurality of transformers comprises a toroid transformer surrounding said drill string;

(bd) at least one said plurality of transformers comprises a toroid transformer disposed on a rig operating said drill string; and

(ee) outputs from said plurality of transformers are combined with a processor in surface equipment to yield said response of said sensor with an enhanced signal to noise ratio.

20.(original) The MWD system of claim 16 further comprising an rig voltage receiver, wherein:

(a) said rig voltage receiver measures a modulated voltage signal resulting from said modulated signal current; and

(b) output of said rig voltage receiver and said current receiver are combined to yield said response of said sensor with an enhanced signal to noise ratio.

21.(original) The MWD system of claim 16 wherein said response signal is a voltage.

22.(original) The MWD system of claim 16 wherein said response signal is a current.

23.(currently amended) A method for receiving a signal produced by an electromagnetic telemetry system, the method comprising:

(a) detecting, with a transformer, a modulated signal current created in a drill string pipe by measuring a response signal induced in said transformer by said modulated signal current; and

(b) demodulating said response signal with a current receiver cooperating with said transformer thereby receiving said signal.

24.(original) The method of claim 23 wherein said transformer comprises a toroid transformer surrounding said drill string.

25.(currently amended) ~~The method of claim 23 comprising the additional steps of~~
A method for receiving a signal produced by an electromagnetic telemetry system, the method comprising:

(a) detecting, with a plurality of transformers, a modulated signal current created in a drill string by measuring a response signal induced in each said transformer by said modulated signal current; and

(b) demodulating said response signal with a current receiver cooperating with each said transformer thereby receiving said signal (a) ~~providing a plurality of said transformers, wherein~~

(i) at least one of said plurality of transformers comprises a toroid transformer surrounding said drill string, and

(ii) at least one said plurality of transformers comprises a toroid transformed disposed on a rig operating said drill string; and

(bc) combining outputs from said plurality of transformers to receive said signal with an enhanced signal to noise ratio.

26.(original) The method of claim 23 further comprising the additional steps of:

- (a) providing a rig voltage receiver;
- (b) with said rig voltage receiver, measuring a modulated voltage resulting from said modulated signal current; and
- (c) combining output of said rig voltage receiver and output of said current receiver to receive said signal with an enhanced signal to noise ratio.

27.(original) The method of claim 23 comprising the additional steps of:

- (a) disposing said transformer in an annulus defined by a wall of a borehole and an outside diameter of casing;
- (b) disposing said current receiver remote from said transformer; and
- (c) operationally connecting said transformer and said current receiver by means of a communication link.

28.(currently amended) The method of claim 23 further comprising disposing said transformer underwater at a location where said drill ~~string~~ pipe enters a borehole.

29.(currently) The method of claim 23 further comprising disposing said transformer on a casing encompassing a drill ~~string~~ pipe that is operating through a template, wherein said template incorporates at least one completed well.

30.(original) The method of claim 23 wherein said response signal is a voltage.

31.(original) The method of claim 23 wherein said response signal is a current.

32.(currently amended) A method for telemetering a signal from a downhole assembly to an uphole location while drilling a borehole, the method comprising:

- (a) disposing an electromagnetic transmitter within said downhole assembly, wherein said transmitter ~~creates~~ cooperates with a sensor to create a modulated signal current in a drill string operationally connected to said downhole assembly;

(b) disposing a telemetry receiver system uphole from said downhole assembly, said telemetry receiver system comprising

(i) a transformer which measures said modulated signal current, and

(ii) a current receiver cooperating with said transformer;

(c) with said current receiver, measuring a response signal induced in said transformer by said signal current; and

(d) with said current receiver, demodulating said response signal to yield said signal.

33.(original) The method of claim 32 wherein said transformer comprises a toroid transformer surrounding said drill string.

34.(currently amended) ~~The method of claim 32 comprising the additional steps of:~~
A method for telemetering a signal from a downhole assembly to an uphole location while drilling a borehole, the method comprising:

(a) disposing an electromagnetic transmitter within said downhole assembly, wherein said transmitter creates a modulated signal current in a drill string operationally connected to said downhole assembly;

(b) disposing a telemetry receiver system uphole from said downhole assembly, said telemetry receiver system comprising

(i) a plurality of transformers which measure said modulated signal current, and

(ii) a current receiver cooperating with each said transformer;

(c) with said current receiver, measuring a response signal induced in each said transformer by said signal current; and

(d) with said current receiver, demodulating said response signal to yield said signal. ~~(a) providing said telemetry receiver system with a plurality of said transformers, wherein~~

~~(i) at least one of said plurality of transformers comprises a toroid transformer surrounding said drill string, and~~

(ii) at least one said plurality of transformers comprises a toroid transformer disposed on a rig operating said drill string; and

(b) combining outputs from said plurality of transformers to yield said signal with an enhanced signal to noise ratio.

35.(original) The method of claim 32 comprising the additional steps of:

(a) providing said telemetry receiver system with a rig voltage receiver, wherein said rig voltage receiver measures a modulated voltage signal induced by said modulated signal current; and

(b) combining outputs of said rig voltage receiver and said current receiver to yield said signal with an enhanced signal to noise ratio.

36.(original) The method of claim 32 wherein said response signal is a voltage.

37.(original) The method of claim 32 wherein said response signal is a current.

38.(currently amended) A method for measuring a parameter of interest while drilling a borehole, the method comprising:

(a) providing a downhole assembly that terminates a lower end of a drill string, wherein said downhole assembly comprises

(i) a sensor, and

(ii) a transmitter, wherein said transmitter ~~creates~~ cooperates with said sensor to create a modulated signal current in a said drill string which is indicative of a response of said sensor to said parameter of interest;

(b) providing a telemetry receiver system comprising

(i) a transformer which measures said modulated signal current, and

(ii) a current receiver cooperating with said transformer;

(c) measuring, with said current receiver, a response signal induced in said transformer by said signal current;

(d) demodulating with said current receiver said response signal to yield said response of said sensor; and

(e) transforming said response of said sensor into a measure of said parameter of interest.

39.(original) The method of claim 38 wherein said transformer comprises a toroid transformer surrounding said drill string.

40.(original) The method of claim 38 further comprising the steps of:

- (a) providing surface equipment which cooperates with said current receiver; and
- (b) converting said response signal into said parameter of interest using said surface equipment.

41.(currently amended) ~~The method of claim 38 wherein:~~ A method for measuring a parameter of interest while drilling a borehole, the method comprising:

(a) providing a downhole assembly that terminates a lower end of a drill string, wherein said downhole assembly comprises

(i) a sensor, and

(ii) a transmitter, wherein said transmitter creates a modulated signal current in said drill string which is indicative of a response of said sensor to said parameter of interest;

(b) providing a telemetry receiver system comprising

(i) a plurality of transformers each which measures said modulated signal current, and

(ii) a current receiver cooperating with each said transformer;

(c) measuring, with said current receiver, a response signal induced in each said transformer by said signal current;

(d) demodulating with said current receiver said response signal to yield said response of said sensor; and

(e) transforming said response of said sensor into a measure of said parameter of interest ~~(a) said telemetry receiver system comprises a plurality of said transformers; wherein~~

(b)f) at least one of said plurality of transformers comprises a toroid transformer surrounding said drill string;

(eg) at least one said plurality of transformers comprises a toroid transformer disposed on a rig operating said drill string; and

(dh) outputs from said plurality of transformers are combined with a processor in said surface equipment to yield a measure of said parameter of interest with an enhanced signal to noise ratio.

42.(original) The method of claim 40 further comprising:

(a) providing said telemetry receiver with a rig voltage receiver;
(b) measuring, with said rig voltage receiver, a modulated voltage signal induced by said modulated signal current; and

(c) combining outputs of said rig voltage receiver and said current receiver with a processor in said surface equipment to obtain a measure of said parameter of interest with an enhanced signal to noise ratio.

43.(original) The method of claim 38 wherein said response signal is a voltage.

44.(original) The method of claim 38 wherein said response signal is a current.

45.(original-allowed) A method for measuring a parameter of interest while drilling a borehole, the method comprising:

(a) providing a downhole assembly that terminates a lower end of a drill string, wherein said downhole assembly comprises

(i) a sensor, and
(ii) a transmitter, wherein said transmitter creates a modulated signal current in a drill string which is indicative of a response of said sensor to said parameter of interest;

(b) providing a telemetry receiver system comprising
(i) a transformer which measures said modulated signal current, and
(ii) a receiver cooperating with said transformer;

- (c) with said sensor inactive, measuring with said receiver a noise response signal induced in said transformer by said signal current;
- (d) with said sensor activated, measuring with said receiver a signal plus noise response signal induced in said transformer by said signal current;
- (e) combining said noise response signal with said signal plus noise response signal to obtain said response of said sensor; and
- (f) transforming said response of said sensor into a measure of said parameter of interest.

46.(original-allowed) The method of claim 45 further comprising the additional step of analyzing said noise response signal to determine optimum conditions under which to measure said signal plus noise response signal.

47.(original-allowed) The method of claim 45 wherein said noise response signal and said signal plus noise response signal are voltages.

48.(original-allowed) The method of claim 45 wherein said noise response signal and said signal plus noise response signal are currents.

49.(currently amended) A telemetry receiver system for detecting a signal, said telemetry receiver system comprising:

- (a) a toroid which measures a modulated signal current ~~created in that flows in~~ a drill string from a sensor cooperating with a transmitter, wherein said toroid surrounds casing encompassing said drill string; and
- (b) a current receiver cooperating with said toroid
 - (i) to measure a response signal induced in said toroid by said modulated signal current, and
 - (ii) to demodulate said response signal to obtain said signal.

50.(original) The telemetry receiver system of claim 49 wherein:

- (a) said toroid is disposed in an annulus defined by a wall of a borehole and an outside diameter of said casing;

- (b) said current receiver is disposed at the surface of the earth; and
- (c) said toroid and said receiver are operationally connected by means of a communication link.

51.(original) The telemetry receiver system of claim 49 wherein said toroid is disposed underwater at a location where said casing enters a borehole.

52.(original) The telemetry receiver system of claim 49 wherein said toroid is disposed around casing encompassing a drill string operating through a template, wherein said template incorporates at least one completed well.

53.(currently amended) A measurement-while-drilling telemetry system comprising:

- (a) a transmitter disposed within a downhole assembly operationally attached to a drill string operated by a rig, wherein said transmitter ~~creates~~ cooperates with a sensor to create a modulated signal current in said drill string; and

- (b) a telemetry receiver system comprising
 - (i) a toroid which measures said modulated signal current, and
 - (ii) a current receiver cooperating with said toroid
to measure a response signal induced in said toroid by said
signal current, and

to demodulate said response signal to yield a signal from
said transmitter; wherein

- (c) said toroid is located remote from said rig to optimize said signal with respect to noise.

54.(currently amended) A method for receiving a signal produced by an ~~electromagnetic~~ a telemetry system, the method comprising:

- (a) detecting, with a toroid surrounding casing in which a drill string is disposed, a modulated signal current created in said drill string by a remote transmitter,

by measuring a response signal induced in said toroid by said modulated signal current;
and

(b) demodulating said response signal with a current receiver cooperating with said toroid thereby receiving said signal.

55.(original) The method of claim 54 comprising the additional steps of:

(a) disposing said toroid in an annulus defined by a wall of a borehole and an outside diameter of said casing;

(b) disposing said current receiver at the surface of the earth; and

(c) operationally connecting said toroid and said receiver by means of a communication link.

56.(original) The method of claim 54 comprising the additional step of disposing said toroid underwater at a location where said casing enters a borehole.

57.(original) The method of claim 54 comprising the additional step of disposing said toroid around casing encompassing a drill string operating through a template, wherein said template incorporates at least one completed well.

58.(currently amended) A method for telemetering a signal from a downhole assembly to an uphole location while drilling a borehole:

(a) disposing a transmitter within a downhole assembly operationally attached to a drill string operated by a rig, wherein said transmitter ~~creates~~ cooperates with a sensor to create a modulated signal current in said drill string;

(b) providing a telemetry receiver system comprising

(i) a toroid which measures said modulated signal current, and

(ii) a current receiver cooperating with said toroid

to measure a response signal induced in said toroid by said modulated signal current, and

to demodulate said response signal to yield said signal from said transmitter; and

(c) locating said toroid remote from said rig to optimize said signal with respect to noise.